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THE HEAD CAPSULE OF SELECTED HESPERIOIDEA¹

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INTRODUCTION

THE HIGHER CLASSIFICATION of the Hesperioidea has never been quite satisfactory despite the efforts of Scudder (1872), Watson (1893), Evans (1937, 1949, 1951, 1952, 1955) and others. Scudder included everything in the Hesperioidea under the "family" Urbicolae, a suprageneric name credited to Fabricius in 1793. The Hesperiidae comprised the main family in E. Y. Watson's (1893) classification because in the British Museum the Megathymidae and the Euschemonidae were arranged as part of the Heterocera (Castniidae). Lindsey, Bell, and Williams (1931) finally divided the Hesperioidea into three families: Megathymidae, Hesperiidae, and Euschemonidae. Evans (1949, 1955), however, considered the Euschemonidae to be part of the Pyrginae and the Megathymidae as a subfamily related to the Hesperinae.

Morphological studies have been done on the papilionids, such as those of Ehrlich (1958a, 1958b), Ehrlich and Ehrlich (1962), and Crombach (1967). The only morphological study done on a hesperioid was by Ehrlich (1960) on *Epargyreus clarus* (Cramer), a pyrgine.

As part of the present study a complete sclerotic morphological survey was done on a few of the hesperioids. With the exceptions of wing venation, wing articulations, genitalia, and relative size differences, the greatest variation was in the ele-

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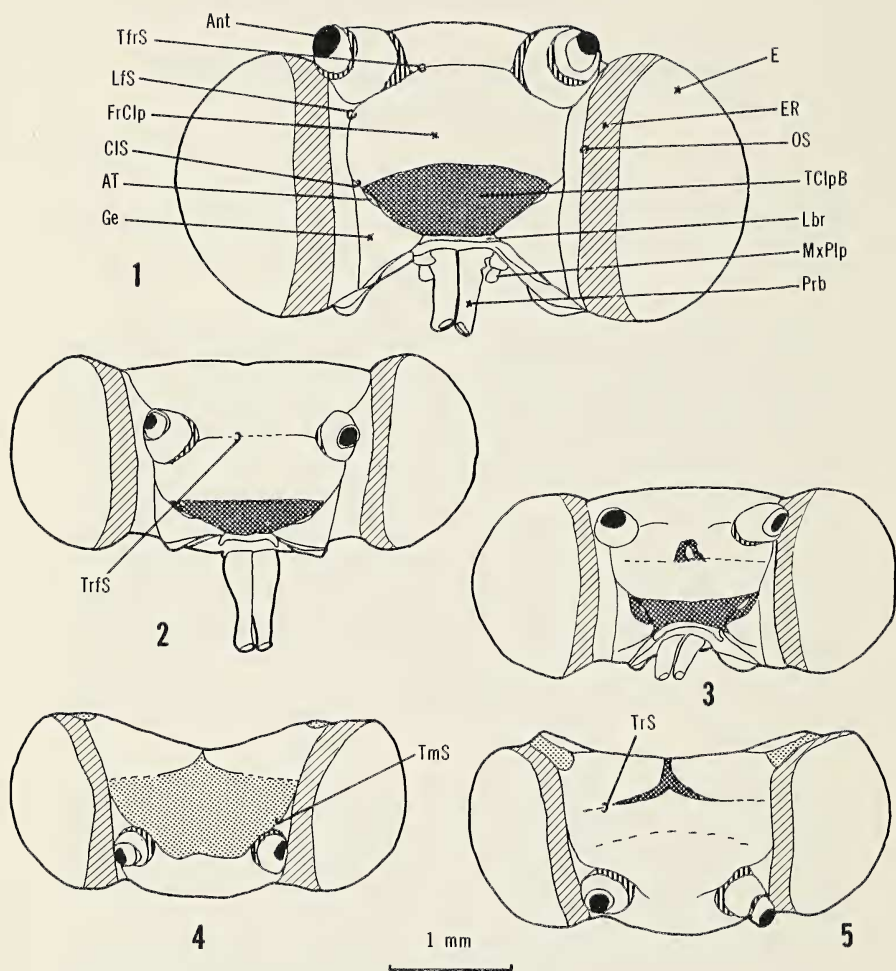


Fig. 1. *Megathymus yuccae*, anterior view. (Example of full transfrontal suture. Sclerotized patterns on frontoclypeus have been removed, see fig. 41.) 2. *Urbanus dorantes*, anterior view (Partial transfrontal suture). 3. *Tagiades flesus*, anterior view (ornamentation of transclypeal band around anterior tentorial pits). 4. *Pyrgus oileus*, dorsal view (simple transverse sutures). 5. *Tagiades flesus*, dorsal view.

ments of the head capsule. Such structures as the antennae and the labial palpi already described by Evans and others will not be discussed here.

The aim of the present study is primarily morphological, rather than taxonomic, but comparison of certain morphological characters may indirectly clarify the relationships of these various representatives phylogenetically. Since there were only a limited number of specimens available for dissection, no definite taxonomic conclusions will be drawn.

METHODS AND MATERIALS

Dried specimens or specimens preserved in 70% alcohol were used. No special differences were noted morphologically between material preserved in either manner. The head was removed, wetted with 70% alcohol and macerated in 10% KOH.

All dissections were made in wetting solution. Scales and heavy hair tufts were removed with probes. In order to observe some structures in detail, the heads were bleached in Clorox and the sclerites stained lightly in a weak mercurochrome solution.

Drawings were made using a Wild M-5 dissecting microscope equipped with a camera lucida.

The terminology used is primarily that of Snodgrass (1935), DuPorte (1946, 1956, 1957, 1959), Imms (1964), and Matsuda (1965).

Forty-one Hesperioidea were studied:

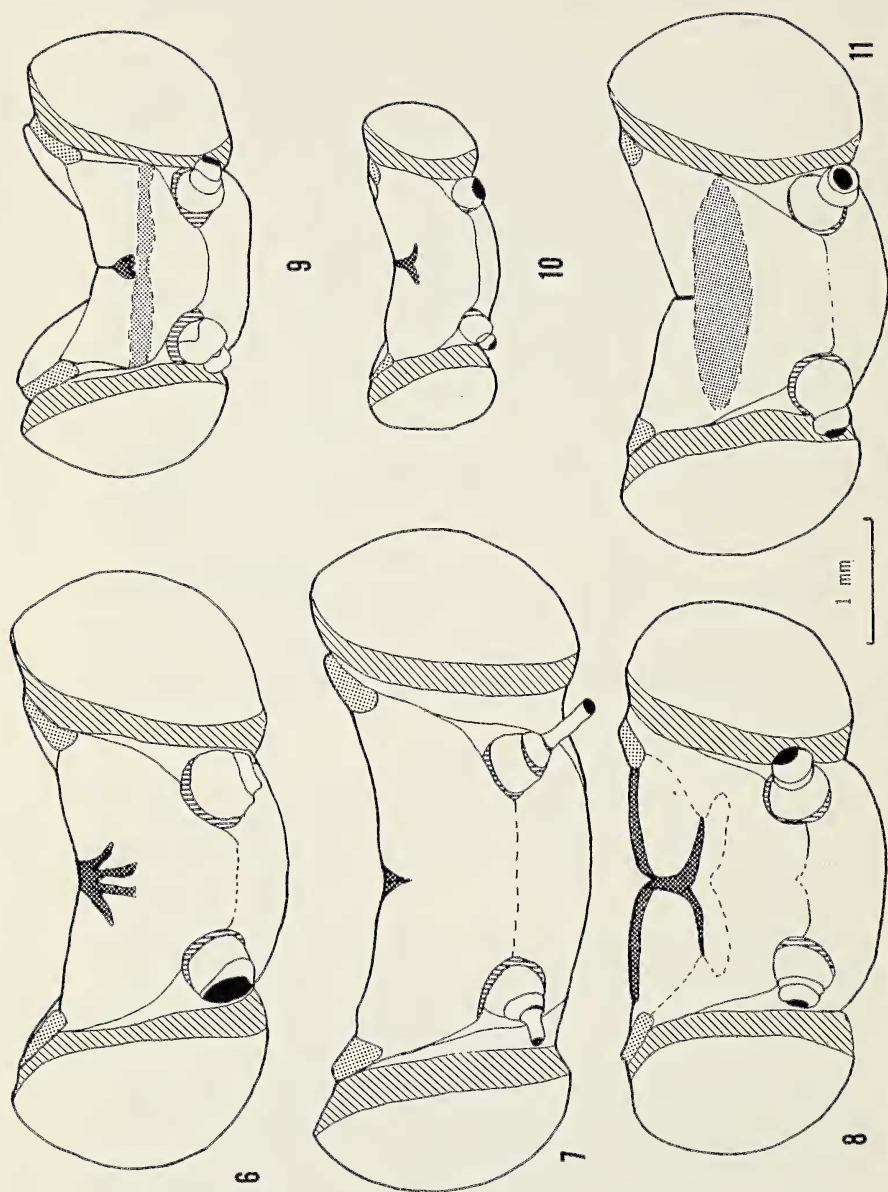
MEGATHYMIDAE: *Megathymus streckeri texana* Barnes and McDunnough, *Megathymus y. yuccae* (Boisduval and LeConte), *Agathymus n. neumoegeni* (Edwards), *Agathymus carlsbadensis* (Stallings and Turner).

HESPERIIDAE:

Hesperinae: *Poanes viator* (Edwards), *Dalla cypselus evages* (Hewitson), *Vettius c. coryna* (Hewitson), *Quinta cannae* (Herrich-Schäffer), *Caenides dacela* (Hewitson), *Telicota colonargeus* (Plötz), *Panoquina sylvicola* (Herrich-Schäffer).

Trapezitinae: *Trapezites s. symmomus* (Hübner), *Hesperilla c. chrysotricha* (Meyrick and Lower), *Signeta flammeata* (Butler), *Motasingha a. atralba* (Tepper).

Pyrginae: *Phocides pigmalion* (Cramer), *Epargyreus clarus* (Cramer), *Urbanus d. dorantes* (Stoll), *Autochton cincta* (Plötz), *Sarmentoia p. phaselis* (Hewitson), *Celaenorrhinus f. fritzgaertneri* (Bailey), *Celaenorrhinus p. proxima* (Mabille),



Figs. 6-11: dorsal views of different types of transverse sutures.
 6. *Agathymus carlsbadensis*. 7. *Hasora badra*. 8. *Mimoniades nirsia*.
 9. *Caenides dacela*. 10. *Purgus adepta*. 11. *Staphylus ascephalus*.

Celaenorrhinus galenus (Fabricius), *Spathilepia clonius* (Cramer), *Staphylus ascaphalus* (Staudinger), *Erynnis z. zarucco* (Lucas), *Pyrgus o. oileus* (Linnè), *Pyrgus communis adepta* (Plötz), *Tagiades flesus* (Fabricius), *Abantis paradisea* (Butler).

Coeliadinae: *Coeliades forestan* (Cramer), *Pyrrhocalcia iphis* (Drury), *Hasora b. badra* (Moore), *Badamia exclamationis* (Fabricius).

Pyrrhopyginae: *Pyrrhopyge araxes arizonae* (Godman and Salvin), *Mimoniades minthe* (Godman and Salvin), *Amenis baroni* (Godman and Salvin), *Mysoria affinis* (Herrich-Schäffer), *Myscelus p. phoronius* (Hewitson), *Mimoniades n. nurscia* (Swainson).

EUSCHEMONIDAE: *Euschemon r. rafflesia* (Macleay).

MORPHOLOGY OF THE HESPERIOID HEAD

The hesperioid head is well differentiated from that of the Papilionoidea by its relative width and widely separated antennae.

Eyes

The most prominent feature of the hesperioid head are the compound eyes (E), which are entire and are bounded by the inner ocular sutures (OS).

Ehrlich (1960) described the hesperioid eye as being divided into two distinct areas: (1) a distal area composed of well developed facets, and (2) an inner eye ring (ER). This eye ring (fig. 1) is particularly evident in bleached specimens and occupies approximately one-fourth to one-third of the area of the eye. In all specimens studied the eye ring was evident and free on the inner edge. Internal examination showed that the eye ring is not an integral part of the head capsule and can be removed intact. Facets are evident over the entire eye upon removal of the eye ring. The nature, approximate size, and location of the eye ring were the same whether examined in fresh or preserved material.

Face

The literature describing the specific morphological structures of the butterfly head, and particularly that of the face is rather confusing. Although there are fewer sclerites and sutures present than in the generalized insect head, the interpretation of such structures and their resulting terminology varies markedly with each author (Crombach, 1967).

The face is defined as the anterior portion of the head between the compound eyes (fig. 1). The areas which delimit the

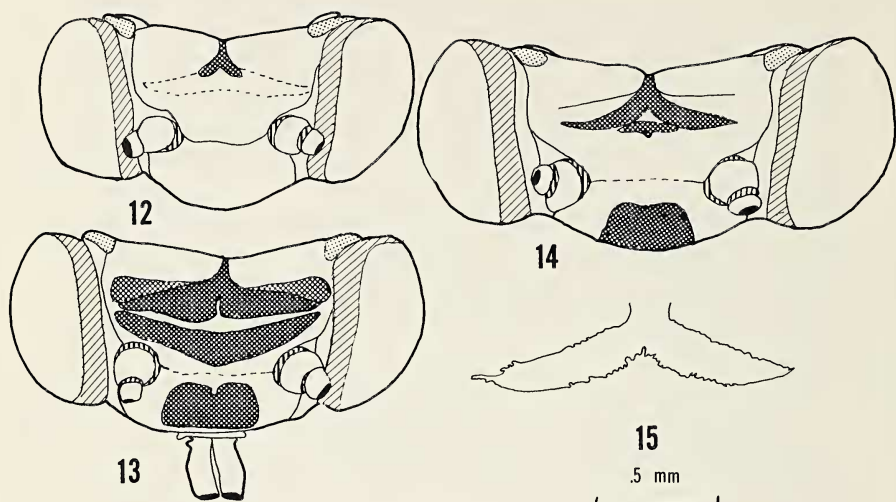


Fig. 15 only

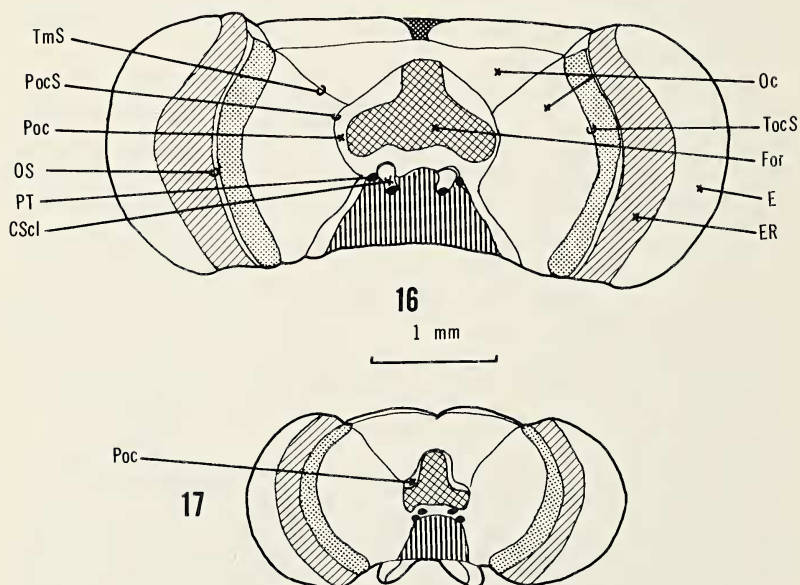


Fig. 12. *Celaenorrhinus proxima*, dorsal view. 13. *Quinta cannae*, dorsal view. 14. *Urbanus dorantes*, dorsal view. 15. *Urbanus dorantes*, enlarged internal view of sclerotized pattern on vertex. 16. *Megathymus texana*, posterior view. 17. *Celaenorrhinus galenus*, posterior view.

face are the paraocular areas or genae, the frontoclypeal sclerite (FrClp), and the dorsal frons.

Since there are marked differences in the various sutures in the hesperioid head, the term suture will be defined in the most stringent terms, *i.e.* a line or space separating two sclerotic areas of the cuticle, with a concomitant ridge evident on the inside of the head capsule.

The transfrontal suture (TrfS) interconnects the antennal sockets. This suture generally falls into one of the following three categories morphologically: a true suture (fig. 1), a partial suture (fig. 2) with a partial ridge occurring on either side internally, and a simple sulcus or line with no raised internal ridge. Table I shows the condition of this suture in the specimens examined. The transfrontal suture appears as a sulcus in members of various groups, but consistently in the Coeliadinae.

The laterofacial suture (LfS) extends from the edge of the antennal socket ventrolaterally to the labium. This suture is generally intersected at its midpoint by a U-shaped clypeolabral suture (CLS). The anterior tentorial pits (AT) lie along the clypeolabral suture and are interconnected by a heavily sclerotized transclypeal band (TClpB). In the Hesperinae, Trapezitinae, Coeliadinae, Euschemonidae, and most of the Megathymidae examined, the anterior tentorial pits lie equidistant from the laterofacial suture and labrum (Lbr).

The anterior tentorial pits are closer to the labrum than to the intersection with the laterofacial suture in the remaining hesperioids studied. In the Pyrrhopyginae the latero-facial suture extends virtually from the intersection of the clypeolabral suture to the labrum. The anterior tentorial pits lie approximately one-fourth the distance between the intersection of the two sutures and the clypeolabral band in this group. In the Pyrginae the anterior tentorial pits lie medially on the clypeolabral suture with a few exceptions: these structures lie nearer to the labrum in *P. pigmalion*, *U. dorantes*, *P. adepta* (fig. 44), and *A. cincta*. The anterior tentorial pits are closer to the laterofacial suture in *C. galenus* and *A. paradisea*.

The transclypeal band is rather smooth in most of the specimens examined. In some cases the area around the anterior tentorial pits may be somewhat sclerotically ornamented, as in *T. flesus* (fig. 3).

Vertex

This region is delimited laterally by the temporal suture (TmS), which extends from the posterior part of the head

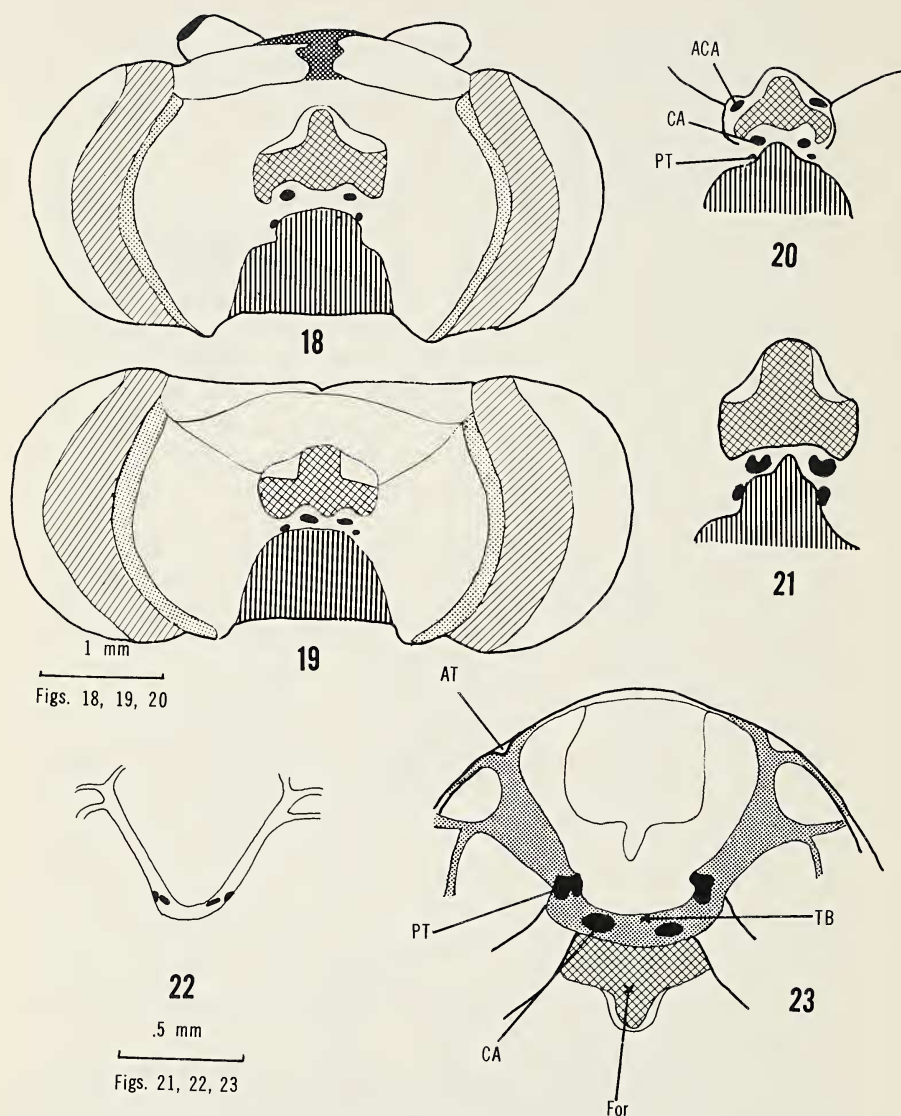


Fig. 18. *Megathymus yuccae*, posterior view. 19. *Mysoria affinis*, posterior view. 20. *Myscelus phoronius*, postocciput and occipital foramen. 21. *Celaenorrhinus proxima*, postocciput and occipital foramen. 22. *Coeliades forestan*, tentorium. 23. *Spathilepia clonius*, tentorium.

capsule to the posterior edges of the antennal sockets. The transfrontal suture separates the vertex from the rest of the hesperioid face. The vertex is delimited also by the epicranial sulcus, which branches anteriorly into two thin transverse sutures (TrS). This condition will be referred to as Type A (fig. 4). An epicranial sulcus of Type A is found in all Trapezitinae and Euschemonidae. The Megathymidae show either Type A or a forked version of Type A (fig. 6). In the Coeliadinae a similar condition to Type A is found, but the transverse sutures branch anteriorly into more of a V-shaped structure (fig. 7). In some cases the transverse sulci form a heavily sclerotized, fused, twin-leaf structure (Type C, fig. 8). This modification is well developed particularly in the Pyrrhopyginae.

Both Types A and C, as well as an intermediate condition, are found in the Hesperinae and Pyrginae. The intermediate condition (Type B, fig. 5) has thin transverse sutures posteriorly with a mid-dorsal line. The area between the sutures and the mid-dorsal line is somewhat lightly sclerotized with the sutures and the mid-dorsal line disconnected. Table II lists the various forms of the transverse sutures found in the Hesperinae and Pyrginae examined.

Three species were exceptional with the transverse suture reduced to a short vertical line and a slight indication of the mid-dorsal line (*C. proxima*, fig. 12, *S. ascapalus*, fig. 11 and *C. dacela*, fig. 9). The sclerotization associated with the transverse sulci is occasionally ornamented (*Q. cannae*, fig. 13 and *U. dorantes*, figs. 14, 15).

No evidence of the paratemporal sutures prominent in the Papilionoidea was found.

Occiput

The occipital region (Oc) is separated dorsally from the vertex by the transoccipital sutures (TocS; the transoccipital band of Ehrlich, 1960) and from the labial region by a ventral membranous area (fig. 16). The centrally located occipital foramen (For) is bounded on three sides by the postocciput and ventrally by the sclerotized bar supporting the cervical articulations (CA). The general shape of the occipital foramen basically falls into two types: (1) an inverted T-shaped structure (fig. 17), found in all Trapezitinae; and (2) a sub-rectangular structure which is rounded dorsally found in all Megathymidae, Pyrrhopyginae, Coeliadinae, and Euschemonidae. Both general shapes are found in the Pyrginae and the Hesperinae. The above observations may be only related to size with type 2 characteristic of larger specimens.

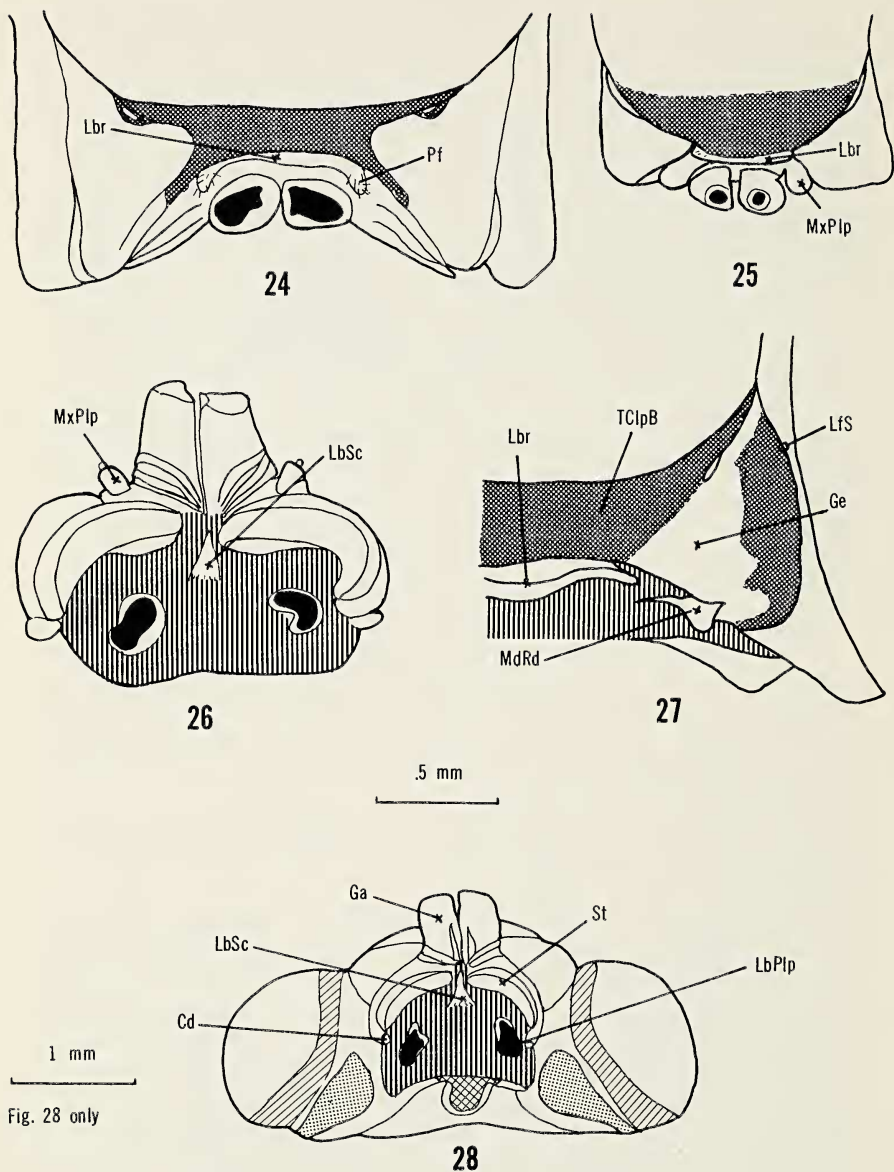


Fig. 28 only

Fig. 24. *Spathilepia clonius*, anterior view (clypeolabral area). 25. *Pyrrochalcia iphis*, anterior view (maxillary palpi). 26. *Agathymus carlsbadensis*, ventral view (maxillary palpi). 27. *Mimoniades minthe*, anterior view (mandibular rudiment). 28. *Megathymus texana*, ventral view.

The postocciput (Poc) is generally obliterated mesad, gradually widens laterally and terminates above the articulations of the cervical sclerites. This structure may appear as a parallel band along the edge of the occipital foramen (fig. 18) or as a well differentiated structure, as in *M. affinis* (fig. 19). Both types and various intergradations between them are found, without any particular relationship to higher categories.

The cervical articulations (CA) lie mesially in the sclerotized bar ventrad of the occipital foramen, except in *C. galenus* and *C. proxima* (fig. 21) in which the bar is sinuate. The posterior tentorial pits (PT) lie ventrolaterally from the cervical articulations.

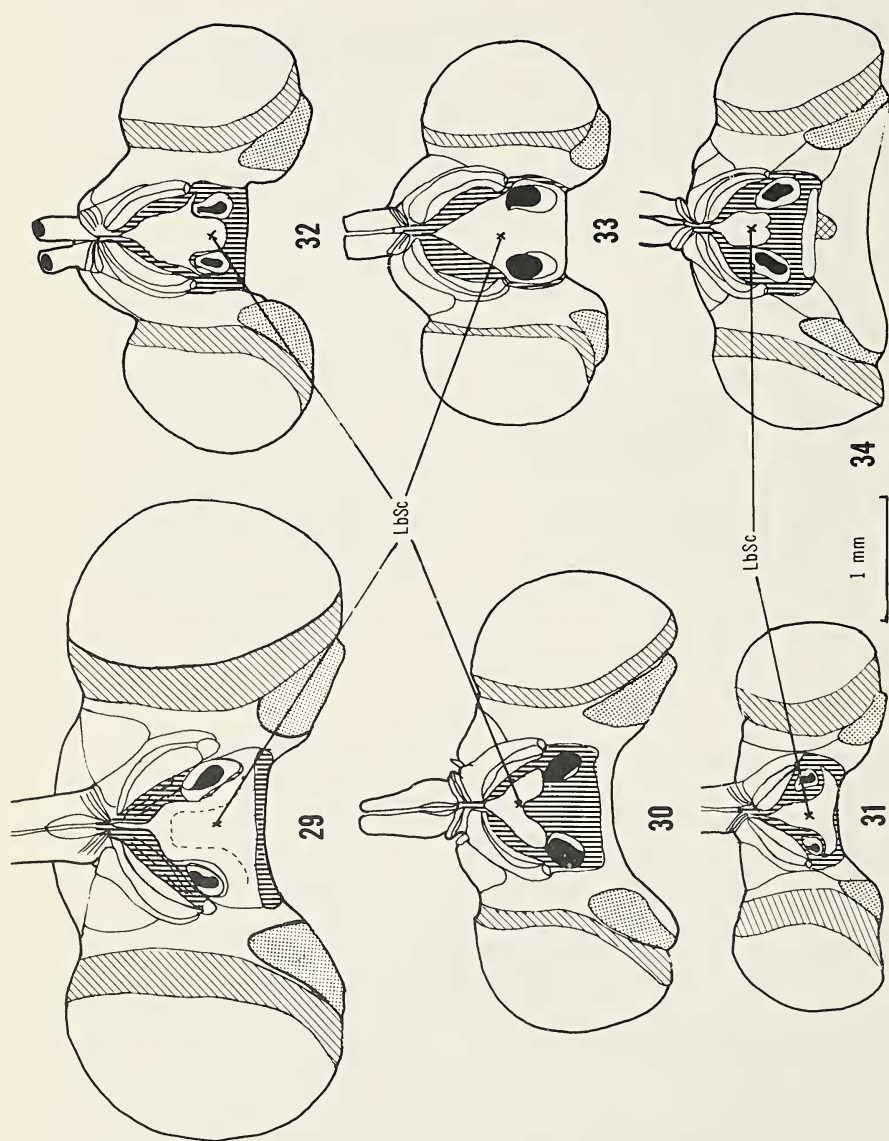
An unusual situation occurs in one of the Pyrrhopyginae studied. Two sets of cervical articulations are found in *M. phoronius* (fig. 20). The auxillary cervical articulations (ACA) are located in the postocciput on either side of the occipital foramen.

Ehrlich (1960) described the occiput as being divided into two regions by the transoccipital suture: an inner darkly sclerotized area and an outer lightly sclerotized one (fig. 16). The lightly sclerotized area also has pronounced hairy sockets and a fine hair fringe covering not only this area, but continuous across the posterior part of the vertex. The exact nature of the lightly sclerotized structures has not been determined, but it was present in all specimens examined.

Mouthparts

The labrum (Lbr) appears as a thin, rectangular, lightly sclerotized bar dorsad of the hypopharynx (fig. 24). The outer edges of the labrum usually are bent downward into the pilifers (Pf). The pilifers may also be reduced (fig. 25). Chaetae are usually found covering the pilifers but in some cases a fringe of hair may cover the entire outer edge of the labrum.

The literature supporting the existence of maxillary palpi (MxPlp) in the case of the Hesperioidea is rather confusing. Philpott (1927) indicated that such structures are present and are two-segmented. Imms (1964) and Forbes (1923) in describing the superfamily indicate that the maxillary palpi are lacking. Maxillary palpi were evident in this study and were observed in three conditions: (1) a conspicuous raised swelling near the base of the proboscis (fig. 25), (2) two-segmented, and (3) three-segmented palpi (fig. 26). All of the Coeliadinae as well as *A. neumogeni*, *Q. cannae*, *T. flesus*, *E. clarus* and *M. nurscia* have the conspicuous swelling at the location of the maxillary



Figs. 29-34: different sizes of labial sclerites. 29, *Mysoria affinis*. 30, *Cacnides dacela*. 31, *Dalla cypselus evages*. 32, *Celaenorrhinus fritzguertneri*. 33, *Celaenorrhinus galenus*. 34, *Quinta canae*.

palpi. Two-segmented palpi were observed in *T. c. argeus*, *C. dacela*, *P. syvicola*, *S. flammeata*, *M. atralba*, *H. chrysotricha*, *S. ascapthalus*, and *E. rafflesia*; whereas *M. texana* *M. yuccae* (figs. 1 or 41) and *A. carlsbadensis* (fig. 26) have three-segmented maxillary palpi.

Another structure which is ill-defined in the literature is the mandibular rudiment (MdRd). The mandibular rudiments are structures which either articulate or are fused with frontoclypeus or the paraocular areas (genae, Ge). In one species, *M. minthe* (fig. 27) a sclerite is present in the membranous area on either side below the labrum and is fused with the gena. There is a pronounced enlargement in the genal area particularly in the Pyrrhopyginae and the Euschemonidae. No enlargement was seen in the other groups.

The labium is quite rudimentary. The labial sclerite (LbSc) in the Hesperioidea generally can be divided into two parts: (1) a small triangular sclerite usually surrounded by a membranous area and located centrally between the stipes (St), and (2) sclerotized rings which surround the articulations of the labial palpi (LbPlp). Each of the articulations of the labial palpi is free except in the Megathymidae (fig. 35) and some Coeliadinae (fig. 36), in which the articulations are continuous with the stipes.

Generally the labial sclerite is reduced, but there is much variation in this area, especially in the Pyrginae and Hesperiinae. The labial sclerite is enlarged in such hesperiines as *C. dacela* (fig. 30) and *Q. cannae* (fig. 34) and terminates anteriorly of the labial sockets. An additional labial bar, a rudiment of the prementum (Snodgrass, 1935 and Ehrlich, 1958a) occurs posteriorly of the labial sockets in *Q. cannae*. In *D. c. evages* (fig. 31) the labial sclerite is enlarged and extends posteriorly, curving around the labial sockets.

The pyrgines *C. fritgaertneri* (fig. 32) and *T. flesus* have enlarged labial sclerites which terminate centrally and anteriorly of the labial palpi. *C. galenus* (fig. 33) and *M. affinis* (fig. 29) have the largest labial sclerites of the species examined. By contrast, the other African *Celaenorhinus* (*C. proxima*) examined had a reduced labial sclerite.

The labial palpi are three-segmented. The proximal segment is longer than the distal one, with the second segment the longest of the three. All of the Coeliadinae had porrect palpi, but many of the remaining groups studied had erect palpi.

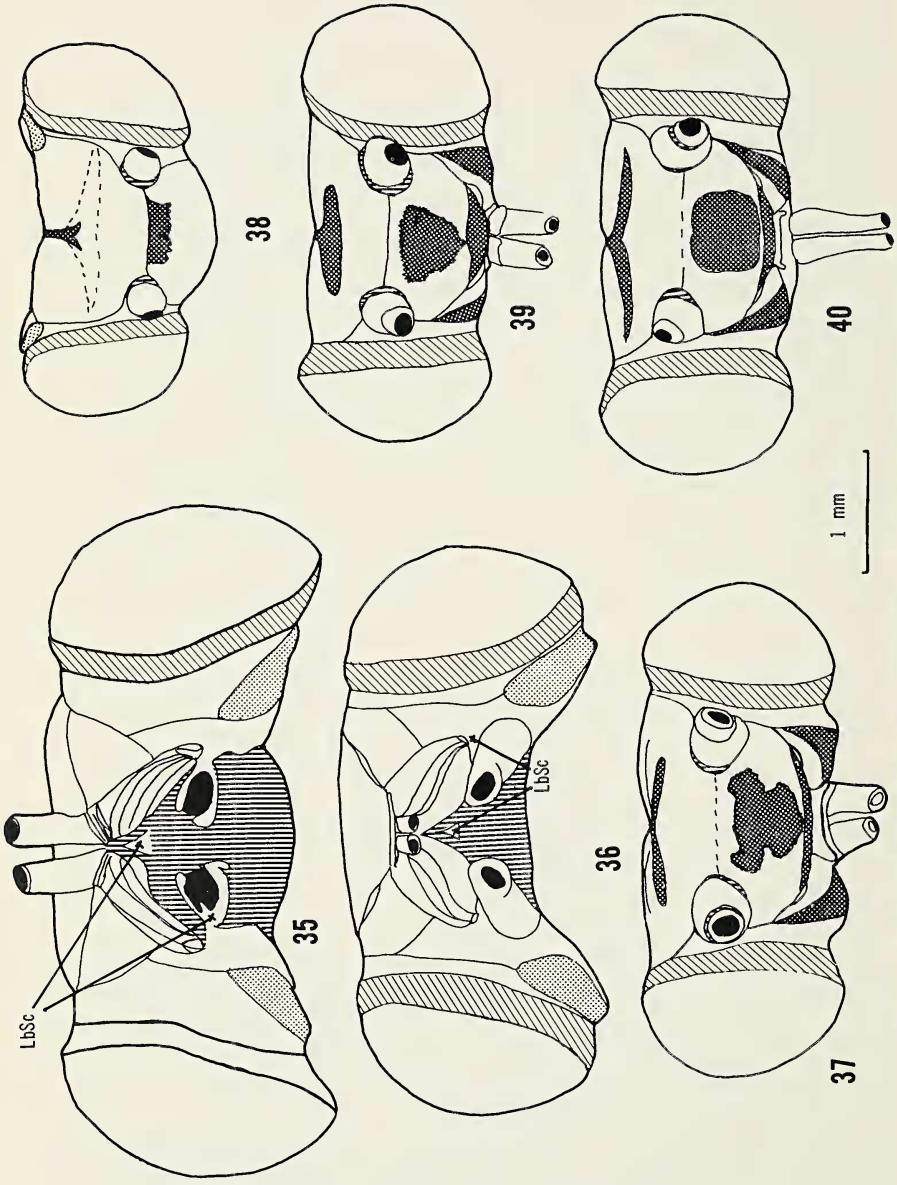


Fig. 35. *Hasora badra*, ventral view. 36. *Megathymus texana*, ventral view. 37. *Spathilepia clonius*, anterior view. 38. *Celaenorrhinus proxima*, dorsal view. 39. *Autochton cincta*, anterior view. 40. *Urbanus dorantes*, anterior view.

Tentorium

The tentorium consists of a posterior tentorial bridge (TB) and two lateral arms which stretch forward from the posterior (PT) to the anterior tentorial pits (AT, fig. 23). The anterior arms generally have well developed wing-like lamellae which taper posteriad toward the tentorial bridge. Sometimes the anterior tentorial arms are not lobate, as in *T. symmokus*, *C. forestan* (fig. 22), *H. chrysotricha*, and *P. a. arizonae*. The lamellae appear to vary with the size of the specimen, i.e. the lamellae are well developed in most Megathymidae, Pyrrhopyginae, Coeliadinae, and Euschemonidae. In most of the Pyrginae and Hesperinae the lamellae are not as well defined.

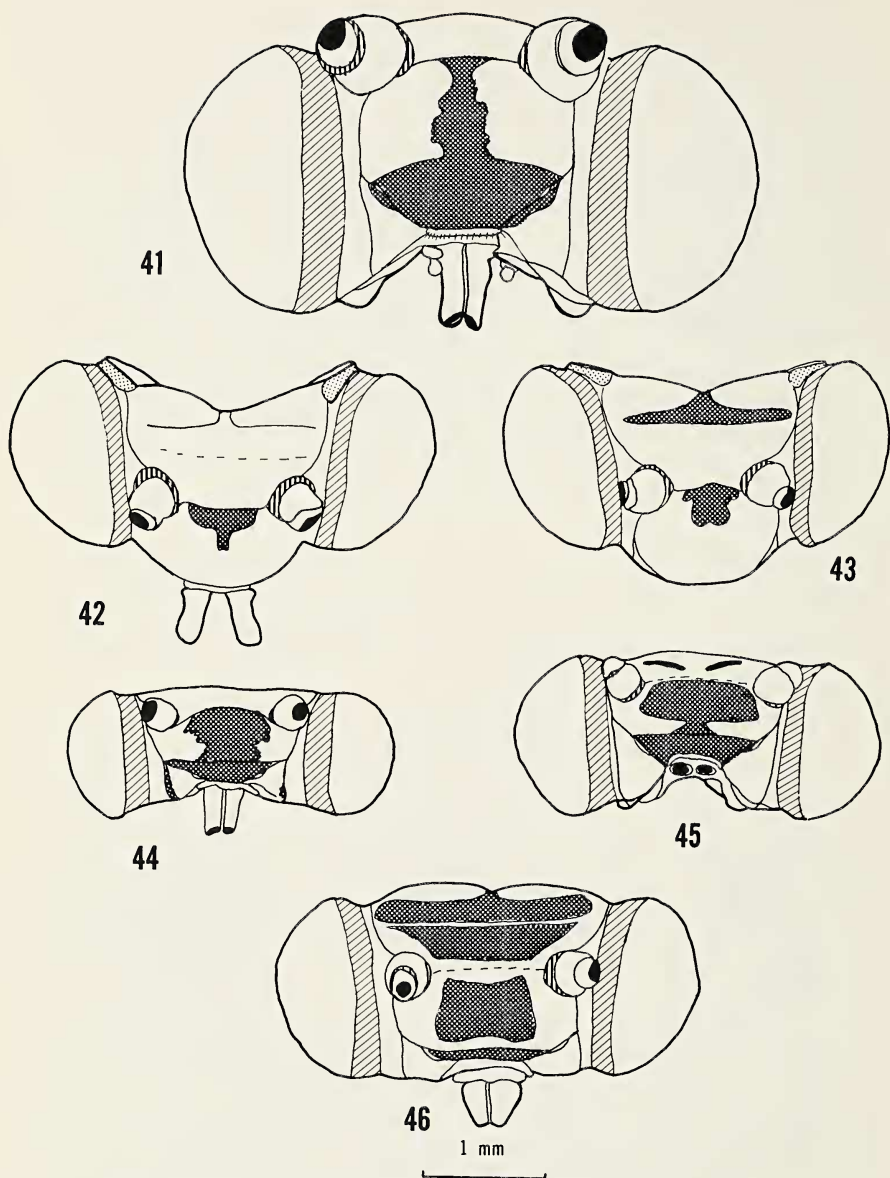
The tentorial bridge is the same sclerotized bar which is observed mesially through the occipital foramen and bears the articulations of the cervical sclerites. The relative distances between these cervical articulations and those of the posterior tentorial pits varies, but no pattern was evident within the respective groups.

A lateral connection at the juncture of the anterior tentorial arm and the anterior tentorial pit with the ocular diaphragm is membranous in most cases or only lightly sclerotized. In the Megathymidae, Pyrrhopyginae and Euschemonidae this lateral connection is heavily sclerotized.

Chaetosema and other ornamentation

Jordan (1923) described the chaetosema as a sensory organ, which is particularly interesting and variable in the Hesperioidea. Most frequently a setiferous patch is found on either side of the occiput at the temporal suture. Other patches may be found, especially in the Hesperinae and Pyrginae, either in front of the antennae on the face or behind the antennae. An additional patch sometimes occurs in the Pyrginae and Hesperinae which is centrally located and immediately below the transfrontal suture.

In addition to the chaetosema the hesperioid head is usually covered with numerous ornamental hair tufts. Beneath these hair tufts a difference in the degree of sclerotization is seen. Some of these sclerotic patterns were discussed already under the section concerning the vertex. Additional patterns are evident, particularly around the transfrontal suture and the clypeolabral suture. Such patterns are found in such hesperiines as *D. evages* (fig. 45) and *Q. cannae* (fig. 46), in some studied pyrgines: *U. dorantes* (fig. 40), *A. cincta* (fig. 39), *C. fritzgaertneri* (fig. 42), *S. clonius* (fig. 37), *P. adepta* (fig. 44), *C. proxima* (fig. 38)



Figs. 41-46: sclerotized patterns on the head capsule. 41. *Megathymus yuccae*, anterior view. 42. *Celaenorrhinus fritzgaertneri*, dorsal view. 43. *Celaenorrhinus galenus*, dorsal view. 44. *Pyrgus adepta*, anterior view. 45. *Dalla cypselus evages*, anterior view. 46. *Quinta cannae*, anterior view.

and *C. galenus* (fig. 43), and in *M. yuccae* (Megathymidae; fig. 41). Although there is constant variation from species to species as to the area in which such ornamentation occurs (*P. oileus*, fig. 4 and *P. adepta*, fig. 44), or even if it will occur, there is no variation within a particular species. A number of dissections were done to verify the above in *Pyrgus* and no variation in the location of the ornamentation could be found. Studies are in progress to determine the nature of these patterns which have nothing to do with the phylogenetic organization of the Hesperioidea other than the fact that they occur most frequently in the Hesperinae and the Pyrginae.

Discussion

Representatives of the three families of Hesperioidea were studied morphologically: Megathymidae, Hesperiidae and Euschemonidae. Structural variation is evident throughout the entire Hesperioidea with structures present or absent with no apparent phylogenetic pattern. Many authorities have divided the Hesperioidea according to the larval feeding habits into two main stocks, the Hesperinae, monocot feeding, and Pyrginae, dicot feeding, series. Rating the two series, the basic arrangement might be, from primitive to more advanced: (Hesperinae series): Megathymidae, Trapezitinae, and Hesperinae; (Pyrginae series): Euschemonidae, Coeliadinae, Pyrginae, and Pyrrhopyginae. Tilliard (1919) regarded *Euschemon* as the most primitive of the superfamily because of the presence of the frenulum.

Forbes (1923) considered the Hesperioidea to be closely aligned to or to have arisen with the Castniidae from the Cossidae. Seitz (1940) believed that the Castniidae were a recently evolved group because of their habits. Castniidae are active particularly in the brightest sunshine, generally visiting white or bright red flowers. The larvae live in stalks, fruits and bulbs of monocots, with many species living in long silk-lined tunnels in or on the ground, reminiscent of the Megathymidae (see also Moss, 1945).

A brief morphological examination made of a few Castniidae showed some definite similarities with the Hesperioidea. The occiput, like that of the hesperioids is divided into lightly and heavily sclerotized areas (fig. 48) in the following Castniids: *Castnia icarus*, *Castnia licus*, *Xanthocastnia viryi*, and *Cabirrus linus*. A few other members of the family examined briefly showed the same structural similarities in the occipital area. The transverse sutures of the vertex are reduced to thin lines (see section on vertex, Type A) characteristic of the more primitive

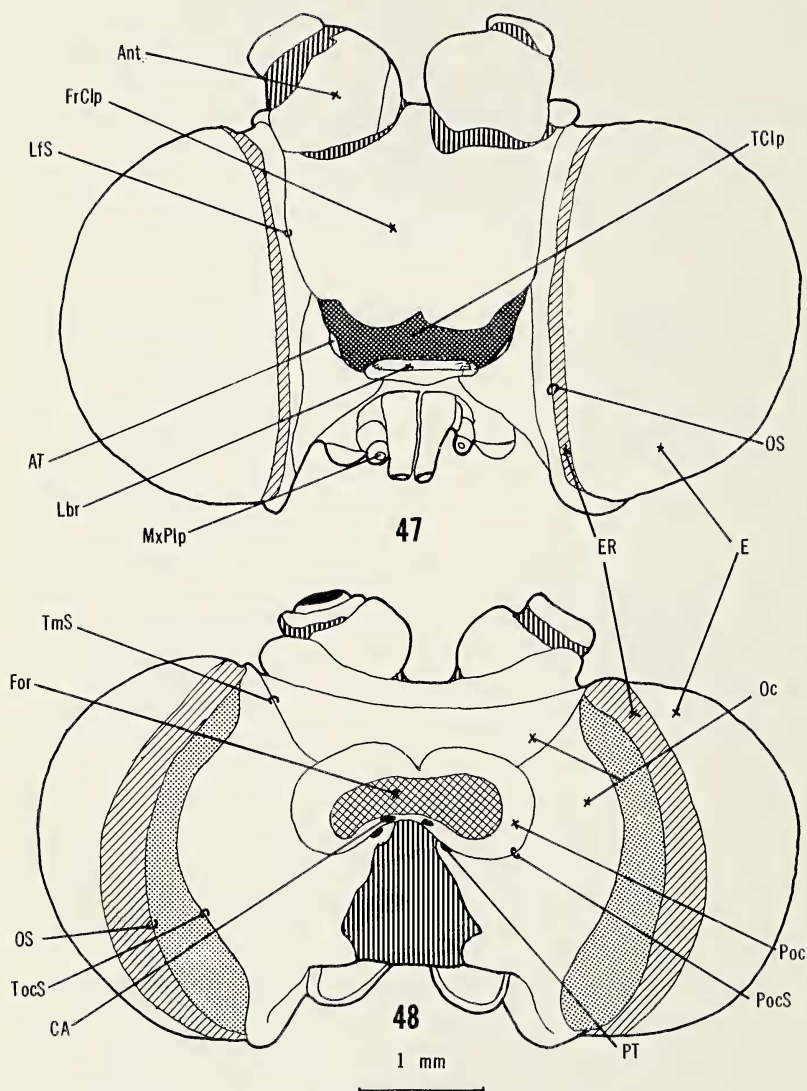


Fig. 47. *Castnia icarus*, anterior view. 48. *Castnia icarus*, posterior view.

skippers. Similarly the shape of the occipital foramen is the same as that of the Megathymidae, Pyrrhopyginae, and Euschemonidae. The labial sclerite is reduced to the triangular sclerite with well developed labial and maxillary palpi. Other structures are not as in the hesperioids. The eyes are entire, but the eye ring is not as well developed anteriorly, with the major portion of the eye ring involuted and heavily sclerotized (fig. 47). The antennae are located very close together, separated, in most cases, by two antennal widths. There is no evidence of the trans-frontal suture of the face present in hesperioids or the paratemporal suture of the vertex in the papilionoids. The tentorium is heavily sclerotized and similar to that of *C. forestan* (fig. 22).

The remote possibility of a relationship of the Cossidae and the Hesperioidea was considered, but no striking similarities were noted.

There is some morphological basis for considering the Hesperioidea closely aligned to the Castniidae. Ehrlich (1960) speculated that the entire eye as well as the eye ring separated the Hesperioidea from the Papilionoidea. With the brief examination of a few castniids, the hesperioids appear to be closely related to the castniids, closer than to the papilionids. The lightly sclerotized areas of the occiput, similarities in the shape of the tentorium and the absence of the paratemporal suture of the vertex further separate the Papilionoidea from the Hesperioidea and the Castniidae.

Forbes (1923, p. 43) described the suborder Rhopalocera including the Hesperiidae, as comprised of butterflies with "ocelli and maxillary palpi always absent." The present study as well as that of Philpott (1927) demonstrates that the maxillary palpi are found not only in the Megathymidae and Euschemonidae but also in the Hesperiidae. These maxillary palpi were found in the primitive skippers, and those of different theoretical phyletic lines. This might support the use of the suborder Grypocera for the skippers, but there are some problems with this terminology, too. Originally the attributes of the suborder Grypocera were exaggerated somewhat so that a logical classification of the skippers would be difficult. The old terms Rhopalocera and Heterocera really are used as a matter of convenience and have very little meaning taxonomically. Lindsey, Bell and Williams (1931) probably approached the situation in the most logical way by accepting the division of the Lepidoptera into the suborders Jugate and Frenatae, with the series Rhopalocera further sub-

TABLE I

Condition of the transfrontal suture in various Hesperioidea

Full Suture	Partial Suture	Sulcus
<i>A. neumaegeni</i>	<i>A. carlsbadensis</i>	<i>M. texana</i>
<i>T. c. argeus</i>	<i>U. dorantes</i>	<i>D. c. evages</i>
<i>C. dacela</i>	<i>S. ascaphalus</i>	<i>Q. cannae</i>
<i>P. viator</i>	<i>T. flesus</i>	<i>V. coryna</i>
<i>T. symmomus</i>	<i>A. paradisea</i>	<i>M. atralba</i>
<i>H. chrysotricha</i>	<i>M. affinis</i>	<i>P. pigmalion</i>
<i>S. flammeata</i>	<i>M. nurscia</i>	<i>S. clonius</i>
<i>E. clarus</i>		<i>E. zarucco</i>
<i>A. cincta</i>		<i>C. forestan</i>
<i>S. phaselus</i>		<i>P. iphis</i>
<i>C. fritzgaertneri</i>		<i>H. badra</i>
<i>C. proxima</i>		<i>B. exclamationis</i>
<i>C. galenus</i>		<i>P. a. arizonae</i>
<i>P. c. adepta</i>		<i>M. minthe</i>
<i>P. oileus</i>		
<i>A. baroni</i>		
<i>M. phoronius</i>		
<i>E. rafflesia</i>		

TABLE II

Conditions of the transverse sutures in the Hesperiiinae and Pyrginae. The types A, B, and C are discussed in the text.

A	B	C
Hesperiiinae	<i>P. viator</i>	<i>Q. cannae</i>
<i>T. c. argeus</i>	<i>D. c. evages</i>	
<i>P. syvicola</i>	<i>V. c. coryna</i>	
	<i>C. dacela</i>	
Pyrginae	<i>E. clarus</i>	<i>P. pigmalion</i>
<i>E. zarucco</i>	<i>C. fritzgaertneri</i>	<i>U. dorantes</i>
		<i>A. cincta</i>
		<i>S. phaselis</i>
		<i>S. clonius</i>
		<i>C. galenus</i>
		<i>A. paradisea</i>

divided into two superfamilies, Papilionoidea and Hesperioidea, leading to the further subdivision of the latter. However, if one considers the Megathymidae a separate family, there is no logical reason for not considering the Trapezitinae or Coeliadinae separate families.

Obviously a taxonomic classification cannot be entirely based on the hesperioid head, but the results of this study support previous classifications. Further studies of the hesperioid anatomy may provide the basis of a stable yet meaningful classification.

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BIBLIOGRAPHY

- CROMBACH, G. T., 1967. A comparative study of the exoskeletons of *Papilio glaucus* L., *Eurytides marcellus* (Cramer), *Battus philenor* (L.) and *Parnassius phoebus* (Fabricius) (Lepidoptera: Papilionidae). Catholic Univ. America, unpublished M. S. dissertation.
- DUPORTE, E. M., 1946. Observations on the morphology of the face of insects. *Jour. Morphol.*, 79: 371-417.
- , 1956. Median facial sclerite in larval and adult Lepidoptera. *Proc. R. Ent. Soc., London*, (A) 31: 109-116.
- , 1957. The comparative morphology of the insect head. *Ann. Rev. Ent.*, 2: 55-70.
- , 1959. Manual of insect morphology. New York, N. Y., Reinhold Publ. Co., 224pp.
- EHRlich, P. R., 1958a. The integumental anatomy of the monarch butterfly *Danaus plexippus* L., (Lepidoptera: Danaidae). *Univ. Kansas Sci. Bull.*, 38: 1315-1349.
- , 1958b. The comparative morphology, phylogeny, and the higher classification of the butterflies (Lepidoptera: Papilionoidea). *Univ. of Kansas Sci. Bull.*, 39: 305-370.
- , 1960. The integumental anatomy of the silver-spotted skipper. *Epargyreus clarus* (Cramer) (Lepidoptera: Hesperidae). *Microent.* 24: 1-23.
- EHRlich, P. R. and A. H. EHRlich, 1962. The head musculature of the butterflies (Lepidoptera: Papilionidae). *Microent.*, 25: 1-89.
- EVANS, W. H., 1937. A catalogue of the African Hesperidae . . . London, *Trustees British Mus. (Nat. Hist.)*: v-xii + 212pp.
- , 1949. A catalogue of the Hesperidae of Europe, Asia, and Australia . . . London, *Trustees British Mus. (Nat. Hist.)*: v-xix + 502pp.
- , 1951. A catalogue of the American Hesperidae . . . Part I. *Pyrrhopyginae*. London, *Trustees British Mus. (Nat. Hist.)*: vii-x + 92pp.

- , 1952. A catalogue of the American HesperIIDae . . . Part II. Pyrginae. Section 1. London, *Trustees British Mus. (Nat. Hist.)*: v + 178pp.
- , 1953. A catalogue of the American HesperIIDae . . . Part III. Pyrginae. Section 2. London, *Trustees British Mus. (Nat. Hist.)*: v + 246pp.
- , 1955. A catalogue of the American HesperIIDae . . . Part IV. HesperIIDae and Megathymidae. London, *Trustees British Mus. (Nat. Hist.)*: v + 499pp.
- FORBES, W. T. M., 1923. The Lepidoptera of New York and neighboring states. Part I. Ithaca, N. Y., *Cornell Univ.*: 729pp.
- IMMS, A. D., 1964. A general textbook of entomology (ninth edit. revised by O. W. Richards and R. G. Davies). London, Methuen & Co., Ltd.: v-x + 886pp.
- JORDAN, K., 1923. On a sensory organ found on the head of many Lepidoptera. *Novit. Zool.* 30: 155-158.
- LINDSEY, A. W., Jr., 1931. E. L. Bell and R. C. Williams, Jr., 1931. The Hesperioidea of North America. *Denison Univ. Bull., Jour. Sci. Labs.*, 26: 1-150.
- MATSUDA, R., 1965. Morphology and evolution of the insect head. *Mem. American Ent. Inst.*, (4): 1-334.
- MOSS, A. M., 1945. The Castnia of Pará with notes on others (Lepidoptera: Castniidae). *Proc. R. Ent. Soc. (B)* 14 Pts. 3-4: 48-52.
- PHILPOTT, A., 1927. The maxillae in the Lepidoptera. *Trans. Proc. N. Z. Inst.* 57: 721-746.
- SCUDDER, S. H., 1872. A systematic revision of some of the American butterflies with brief notes of those known to occur in Essex County, Mass. *Rept. Peabody Acad. Sci.*, 1871: 24-82.
- SEITZ, A., 1940. The Macrolepidoptera of the World. VI. The American Bombyces and Sphinges. Stuttgart, Alfred Kernen Verlag: 1327pp.
- TILLYARD, R. J., 1919. On the morphology and systematic position of the family Micropterygidae (sens. lat.). *Proc. Linn. N. S. W.*, 44: 95-136.
- WATSON, E. Y., 1893. A proposed classification of the HesperIIDae with a revision of the genera. *Proc. Zool. Soc. London*, 1893: 3-132.

ABBREVIATIONS USED IN ILLUSTRATIONS

ACA—auxillary cervical articulations
 Ant—antenna
 AT—anterior tentorial pits
 CA—cervical articulations
 Cd—cardo
 Cls—clypeolabral suture
 E—eye
 ER—eye ring
 For—occipital foramen
 FrClp—frontoclypeus
 Ga—galea
 Ge—gena
 Lbr—labrum
 LbPlp—labial palpus
 LbSc—labial sclerite
 LfS—laterofacial suture

MxPlp—maxillary palpi
 MdRd—mandibular rudiment
 Oc—occiput
 OS—Ocular suture
 Pf—pilifer
 Poc—postocciput
 PocS—postoccipital suture
 Prb—proboscis
 PT—posterior tentorial pits
 TB—tentorial bridge
 TClpB—transclypeal band
 TfrS—transfrontal suture
 TmS—temporal suture
 TocS—transoccipital suture
 TrS—transverse suture